British Astronomical Association

VARIABLE STAR SECTION CIRCULAR

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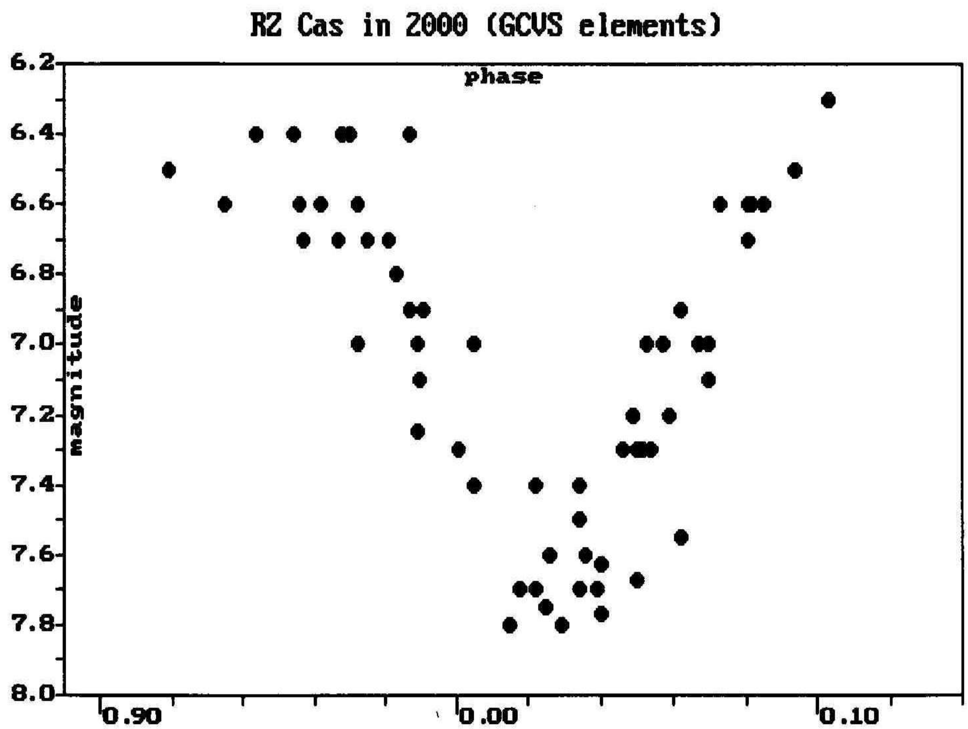
PRELIMINARY ECLIPSING BINARY LIGHT CURVES

TONY MARKHAM

Here are some light curves showing the recent behaviour of some Eclipsing Binaries. The light curves for **RZ Cas**, **Beta Lyr** and **LY Aur** each combine a year's worth of observations. SPA VSS members continue to provide a significant contribution to the observation of Eclipsing Binaries.

RZ Cas 2000 Observers : Matthew Barrett, Michael Clarke, Tony Markham and Melvyn Taylor.

The primary eclipse continues to be significantly later than predicted by the GCVS elements. In 2000, it was centered at about phase 0.03, which corresponds to the eclipse being approx 50 minutes later than predicted by the GCVS elements.



Beta Lyr 2001(see inside back cover) observers : Matthew Barrett, Michael Clarke, Shelagh Godwin, Lindsay Green, Robert Naudziunas and Tony Markham.

Although the GCVS period is given as approx 12.914 days, the period has been in excess of this for many years and is currently around 12.94 days. Hence, although the O-C phase discrepancy for the primary eclipse appears to be only 0.45 in the above light curve, it is in fact late by several cycles plus 0.45.

FROM THE DIRECTOR

Roger Pickard

Sequences

At a recent Officers Meeting (a summary should appear in the next Circular) one of the longest talking points was sequences. Indeed, John Toone and I are hoping to further our discussions on this topic, with the AAVSO this summer.

Thanks to the Hipparcos mission, and the publication of the subsequent Tycho Catalogue, we now have reasonably accurate magnitudes (usually better than 0.05 magnitudes) for all stars down to about magnitude 10.5. However, for stars fainter than this, no sufficiently accurate catalogue exists - yet. Therefore, we must rely on other sources. Help usually comes from either Brian Skiff or Arne Henden in the US, who are professional astronomers who will often “lend a hand”, or more accurately, a CCD observing session to observe selected fields. This has led to a great improvement for a number of sequences, particularly for those stars on the Recurrent Objects Programme. However, these professional astronomers have neither the time nor the interest, at the moment, to observe faint sequences for Mira stars, for example. However, some amateurs now possess the skill and equipment to obtain good photometric sequences to around magnitude 15 or even 16, and I would like to appeal to such observers to come forward and offer their assistance in this respect. I’m hoping to continue my own work in this area in due course but regrettably, my own CCD camera is still awaiting repair. Further details of precisely what is required can be obtained by contacting me; my details are on the back cover.

Old data input

The Section still has a vast amount of data that requires converting to machine readable form. Terry Miles at Crayford is still kindly converting current paper records submitted by observers who don’t have the necessary equipment to submit their observations in this form. In addition, if there is a lull in this workload, then Terry will go back to entering some of the old data (mostly from about 1970 to the late 1990’s). Also, since the meeting in Preston last October, Alex Menarry has started logging quite a number of old reports. However, progress is slow - too slow - and I wish to appeal, once again, to members who feel they may have the occasional hour or two available and who feel they may be able to assist in this valuable work. It is work ideally suited to those cloudy nights when you feel that you’d like to do something useful, but are otherwise frustrated by the typical English conditions!

Finally, I would like to thank all observers who now submit their observations via email or disc, and strongly encourage those who are still thinking about taking the plunge, to actually do so.

Change in E-mail Address for John Saxton

Please note that the e-mail address for John Saxton, the computer secretary has changed. His new e-mail address is **lymmobservatory@hotmail.com**, as given on the back of the circular.

LETTERS

The following letter was sent to Norman Walker, by Maurice Gavin after he read the summary of the VSSC meeting, at which Norman had given a presentation on spectrograph design. The letter is reproduced with Maurice's permission.

I was interested to read of your (Norman's) contribution to this meeting in VSSC#111. For the record, I introduced Buil, via my webpage, to this design of Littrow spectrograph which he has acknowledged. You may have seen my Littrow spectrograph at meetings over the last few years. The exception is that I choose to omit the slit for some point sources.

Littrow goes back over a century and simplifies the design to a single collimator/imager, and obviously the image scale of both focal planes remain identical. This is not necessarily a disadvantage with modest telescope apertures with small star images. The f/ratio of the imaging section must be "faster" (to accomodate the wider dispersed beam) than the collimator section and in all cases the overall f/ratio must >= to the scope exit f/ratio (typically f/6.3 - f/10) to avoid vignetting of the scope.

Swapping the Littrow lens progressively (in a range 50mm fl to 300mm fl with my 1200 l/mm grating) increases the dispersion by the same ratio to match the target/brightness/exposure. My best dispersion is 0.25A/pixel for alpha-Tau etc in Jan 2001 at ***http://www.astroman.fsnet.co.uk/hirespec.htm****, or double that of the Buil result. The page also includes an experimental 0.13A/pixel dispersion of lesser quality!*

Obviously fibre-optic feeds have merit to stabilise a spectrograph removed from the scope. Interesting reading for amateurs is the Harvard IntroSpec Spectrograph at ***http://xxx.lanl.gov/abs/astro-ph/0202233*** *with particular reference to f/ratios through fibre-optic feeds from the scope and calculating overall performance.*

Maurice Gavin - Worcester Park Observatory-UK
www.astroman.fsnet.co.uk   m.gavin@freeuk.com

Deadline for next Circular

The deadline for the September circular will be earlier than usual, and will be 15th July, although any material that can be sent in advance of this date will be appreciated.

Information on Photometry

At the Pro-Am meeting that was held earlier in the year, Norman Walker kindly agreed that some information that he has produced on photometry, could be made generally available to all who are interested, although it should be noted that this article currently does not include figures that are referred to in the text. This is a detailed piece of work which discusses the principles behind making good photometric observations, and should be of interest to anyone who is considering performing photometry. It is available on the web page at **http://www.britastro.org/vss.**

THE FADE OF UY CEN

JOHN TOONE

UY Cen lies just 2 degrees south, preceding NGC 5128 (Centaurus A) and 3 degrees north, preceding NGC 5139 (Omega Cen), a very popular area for deep sky enthusiasts. It is classified as a SR variable with a range of 9.22-11.2 in B, and an uncertain period of 115 days. The spectral classification is K5pvar. It was measured 97 times by the Hipparcos satellite between 1989 and 1993; a range of 6.54 - 7.11 was recorded, with no obvious period.

I drew a chart for **UY Cen** back in April 1984, and I have made the following observations when in the tropics or southern hemisphere:

28 May 1984	7.7	17 April 1986	7.8
2 Jun 1984	7.8	15 Dec 1994	7.6
7 Jun 1984	7.8	10 Dec 1995	7.7
6 Apr 1986	7.6	12 Mar 1999	7.9
12 Apr 1986	7.8	22 Mar 1999	7.9

As can be seen, it did not vary much and kept within the limited range of 7.6-7.9. On the 15 February 2002, however, I received the following message from Colin Henshaw who is currently residing in Oman:

.....Meanwhile, last week I took a look at UY Cen, a bright variable I used to observe regularly from Botswana. It never did much, but hovered around 7.8 - 8.0. Imagine my surprise when I couldn't positively identify it in binoculars! I positively identified the field, but in the position of UY Cen were two faint 10th magnitude stars, either one of which could be UY. I had to take out my 80mm refractor, and decided that the preceding star in the pair was more likely to be the correct object. I estimated it at magnitude 10, using a neighboring field star. I confirmed that I had positively identified UY Cen when I got home the following day, using Sky-Map Pro 7. I have notified the AAVSO, but so far not had any confirmation. Have you any news of this star?

I immediately notified Peter Williams and Fraser Farrell in Australia who quickly confirmed Colin's observation. Here are selected observations that Colin, Peter and Fraser have supplied up to mid March 2002:

7 Feb 2002	10.1	CH	9 Mar 2002	9.7	FF
23 Feb 2002	10.2	CH	14 Mar 2002	9.9	PW
26 Feb 2002	9.8	PW	18 Mar 2002	9.9	PW
6 Mar 2002	9.9	PW			

Until now neither Peter nor Fraser had included UY Cen in their observing programmes, and there does not appear to be many other people who have monitored this star in the past. This means our present information on UY Cen is scant, and we don't know if this current fade is a regular occurrence or not. The range of variation does seem rather large for a SR star of spectral class K, which makes me speculate that it could be a borderline RVb star going through its secondary wave minimum. Alternatively, some eclipse mechanism may be at work here, or possibly this could even be an RCB obscuration. No doubt our southern hemisphere colleagues will let us know its true nature in due course.

MEASURING TIMES OF MINIMUM OF ECLIPSING BINARIES USING A CCD CAMERA

DAVID BOYD

I was interested to discover how accurately a CCD camera attached to a typical amateur telescope could measure the times of minimum of an eclipsing binary. The answer with my equipment appears to be around 1 min or better, which is sufficiently accurate to be able to make useful measurements. This article explains how I achieved this, and some of the problems that were overcome in the process.

Equipment

My telescope is an equatorially mounted 10" f/3.6 Newtonian reflector. I use an HX516 CCD camera with a V-band filter mounted in a 2" diameter cell, which screws directly into the front of the camera. This cell was made for me, to my design by Norman Walker, who also supplied the filter. Although it is not necessary to use a filter for such measurements, I normally keep this permanently attached to the camera to minimise refocusing between observing sessions. As an aside, the circumferential grooves in the 2" barrel of the HX516 are ideal for reproducibly relocating the camera in a 2" focusing mount. The holding screws on my focuser, when tightened, fit neatly into the widest groove in the barrel and enable the camera to be replaced with minimal refocusing needed. This arrangement gives images about 18x14 arc min with pixels of 1.7 arc sec. On a good night with accurate focusing, stars have a FWHM of about 2 pixels or 3.5 arc sec. I find it useful to slightly de-focus the image to broaden the peak over more pixels. This reduces the sensitivity to where the star centre falls relative to the pixel array and reduces the height of the peak. This in turn allows longer exposures before saturation which gives higher counts and lower statistical errors.

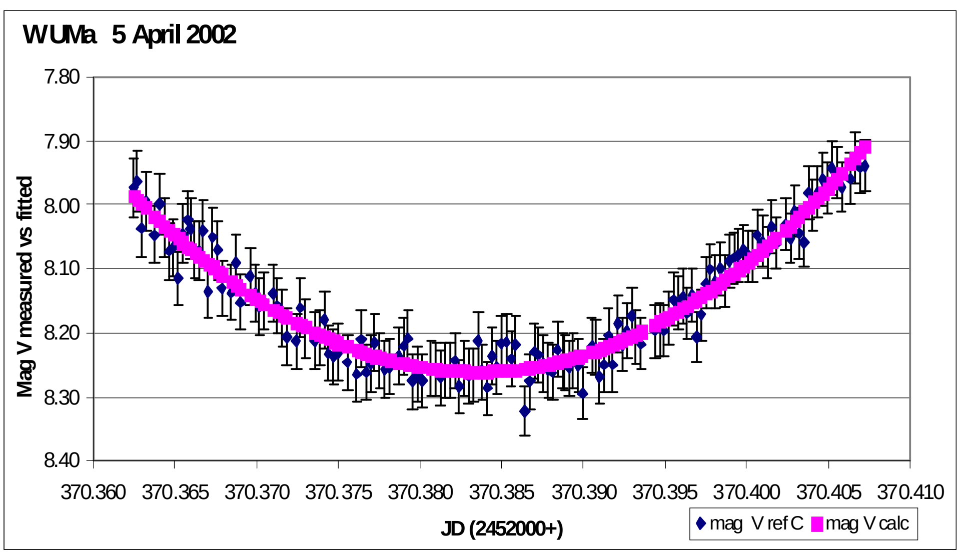
Software

I use the Pixwin software supplied with the camera to control the exposures, and automatically record series of images in FITS format on the hard-drive of a laptop computer. I start imaging about 40 minutes ahead of the predicted time of minimum, and continue until 40 minutes after. Allowing for some uncertainty in the predicted time, this should give me at least 30 minutes of data on either side of the minimum. Much less than this, I have found, starts to compromise the accuracy of the calculated time of minimum. I normally take sequences of images with no additional delay between them. Each exposure involves a delay of 18 seconds as the data is read out and stored on disc, so the maximum possible image rate is about 3 per minute. For a magnitude 8 star, an exposure of 3 seconds gives star images which peak at about 60% of the pixel saturation value. Exceeding this value runs the risk of pixels saturating on some images due to random variation in atmospheric transparency, and movement of the star centre with respect to the pixel array. Pixel saturation must be avoided at all costs as this renders the image useless for measurement. At the end of a run, I take 5 dark frames with the telescope capped using the same exposure as the star images. I then take 5 flat field images, and 5 further dark frames with the same exposure as the flats, for use in calibration. Flat fields are recorded by imaging a white screen illuminated by a portable fluorescent lamp. A sheet of greaseproof paper on a frame over the telescope aperture during the flat exposures helps to diffuse the light, and gives even incident illumination. Exposures of 3 seconds with this arrangement gives flat images with 40-50% saturation. This simple arrangement works well and appears to give reliable results.

AIP4WIN is used for subsequent calibration and automatic analysis of the time series of images. This package is very convenient to use, and I strongly recommend it for time series photometry. The variable, comparison and check stars are measured on each image. The software performs aperture photometry using a circular aperture which it automatically centres on each star, and uses a surrounding annulus to subtract the sky background. The size of the aperture can be chosen according to the width of the stellar profiles for that night. While automatically measuring a series of images, AIP will happily track the stars as they gradually drift from image to image as the run progresses. The data recorded for each image includes the Pixwin-generated time of mid-exposure and the V, C and K counts together with sky background count per pixel. AIP outputs this data as a text file which can be easily loaded into Excel for subsequent analysis.

Data analysis

The counts are converted to instrumental magnitudes, using the normal -2.5log(count) formula. I use the procedure described by Steve Howell in Chapter 4 of his book *Handbook of CCD Astronomy (Cambridge University Press)*, to calculate a statistical error for each measured magnitude. As a sanity check, for the comparison star this generally produces calculated error values similar to or slightly larger than the standard deviation of the measured values. The figure below shows the measured V-C magnitudes for a minimum of **W UMa**. The errors in this case are quite large, as the only available comparison star in the frame is about 2.7 magnitudes fainter. To derive the time of minimum, I perform a least-squares fit of a function of the form $at^2 + bt + c$, to the measurements, where t is time and a, b and c are constants to be fitted. This captures the essentially quadratic nature of most EB minima, but with a term to allow for any skew in the light curve. Some minima have a flat bottom, which this formula does not fit particularly well at the lowest part of the light curve. However, even in these cases, the time of minimum is most strongly determined by the shape of the falling and rising parts of the light curve which the formula does fit reasonably well. The fitted light curve for this minimum of W UMa is also shown in the figure. To compare the derived time of minimum with a



published prediction, a heliocentric correction must be applied to the derived value. I calculate this using Lew's Heliocentric Correction spreadsheet at **http://www.geocities.com/CapeCanaveral/Hall/8449/SUNTime.htm.**

This finally gives me my observed time of minimum in HJD. A calculated time of minimum for the variable in HJD can be found using the latest published ephemeris, for example from the SAC database **at http://www.oa.uj.edu.pl/ktt/rcznk.html**. The difference between these gives the O-C value for that particular minimum. For the W UMa minimum in the figure, an O-C value of -0.00253JD (or 3 min 39 sec) was found.

Accuracy of the recorded time of measurements

Clearly accurate measurement of time is central to this endeavour. My goal was to establish and record the mid-time of each exposure to 2 seconds accuracy over a period of up to 2 hours. I found 3 separate causes of timing inaccuracies, any of which would have significantly exceeded this error and rendered the derived O-C value unreliable.

I reset the computer clock to within a second of UT at the start of each run. The Pixwin software claims to record the mid-exposure time in the FITS header of each image. In practice, my copy of the software records a time 8 seconds after the correct mid-exposure time, regardless of the exposure duration. For a 2 seconds exposure, the recorded time is 7 seconds after the exposure ended! This can be corrected by removing 8 seconds from all recorded times in subsequent analysis. During readout of each image, my PC clock freezes temporarily and then recovers by jumping forward by about 17 seconds after the download is complete. However, the PC clock systematically loses 0.23 seconds each time an image is read out. Over a 200 image run this amounts to 46 seconds, and would shift the derived time of minimum by 23 seconds. This is corrected by incrementally correcting the recorded time of each image by 0.23 seconds.

Finally, the Pixwin software has the *feature* that, if you interact with any application while the exposure is underway, the PC clock does not jump forward by 17 seconds after the readout is complete, and the PC clock is therefore 17 seconds slow from then on. The recorded times of all subsequent images are then incorrect by this amount. This sensitivity to interaction is only during the exposure. If you attempt to interact during the download period, there is no effect (nor will the PC respond as it is frozen during download). The remedy for this is to leave the computer well alone while it is recording images!

Accuracy of the calculated time of minimum

It is complex to analytically derive a value for this. I have instead adopted a pragmatic approach. Re-computing seperate times of minimum using first the even, and then the odd sets of images from a sequence, gives an indication of the sensitivity of the value derived from a given set of observations. This gives an variation of around 0.00015JD or 13 seconds. Also, by repeating the measurement of O-C for the same star several times over a period of 2 weeks, a further indication of the accuracy of derived values can be obtained. This gave a standard deviation for 4 measurements of 0.0007JD or 1 minute. I suspect a significant component of this variation is due to the less than perfect observing conditions I experienced during April, as I rarely got a clear run without some cloud or haze interfering.

This accuracy is comparable with the errors on measured times of minimum of EBs quoted in the IBVS, so it appears that this procedure, if carefully applied, is capable of measuring times of EB minima which are of publishable quality.

PHOTOMETRIC CALIBRATION OF AN MX516 CCD CAMERA USING HIPPARCOS STARS

RICHARD MILES

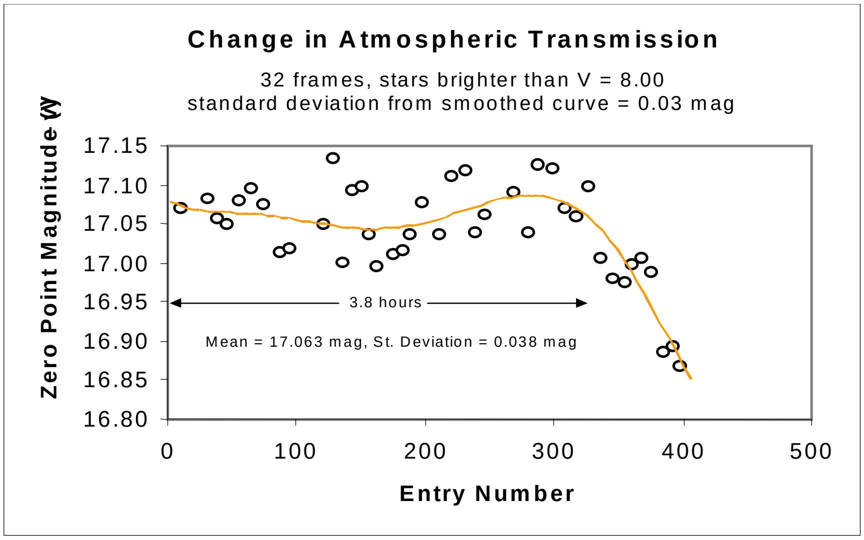
This is an account of a talk that Richard gave at the Pro-Am meeting held at Cambridge earlier this year, and includes the discussion that took place, after the talk.

Most CCD work to date has involved differential photometry of stars and other objects. The aim of this project, is to explore the possibilities for using CCDs to carry out V-band photometry of asteroids. Unlike most variable stars, asteroids have the advantage that they are all of a fairly uniform colour, having a B-V index mostly in the range of +0.7 to +1.0. By contrast, many of the programme stars of the VSS have B-Vs of +2, +3 or +4, or even redder than this.

Andy Hollis and myself realised that there is a whole area of work that could be attempted by people equipped with CCDs. This has been made possible, since the publication of the Hipparcos catalogue, which is a compilation of about 118,000 stars measured both photometrically and astrometrically to high accuracy. The only constraint, when doing photometry by our method, is that when the observer takes CCD frames, she or he has to catch a number of these Hipparcos stars in the image field, to tie the measurements to the standard system; the only way of doing this, at present, is to use a very small telescope, i.e. not the usual 35 cm diameter, but a much smaller aperture such as, in this case, one of 3.5 cm. The key thing is that the field size, here covering some 3.4 square degrees of sky, should normally capture a half a dozen or so Hipparcos stars. So if you think about it, what is the type of programme you might want to become involved with? In the Asteroids and Remote Planets Section, we encourage monitoring of the brighter asteroids, whilst in the VSS there are many Binocular Variables, which form quite a long list of targets that could be suitable for observers equipped with CCDs.

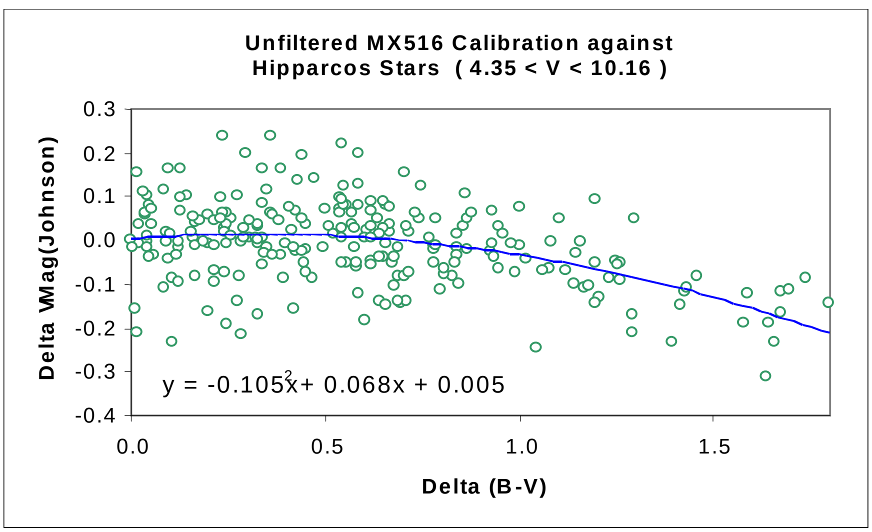
The other thing we realised, is that we should try and keep the project simple, because if you want to popularise the use of CCDs, it's all well and good doing the job properly, as professionals do, but there's actually an area of work that amateurs can target, by snatching large pieces of sky with a very simple arrangement. You don't need to drive the telescope; you don't need to use a filter; you don't need to flat field; you don't need to dark subtract; and in fact you even adjust the image to be a little out of focus, as we don't want high resolution! Indeed this methodology runs counter to what most amateurs strive to achieve, but it is, in fact, just what is needed for this type of V-band photometry.

I suggested to Andy, that maybe the simplest way to start was to just point the telescope at the meridian, say at a declination of about +20° and let the stars drift by, whilst taking short (8 second) CCD exposures at regular intervals of about 5 minutes. He did that for more than five and a half hours, but fortunately he didn't have to stand there for all of that time, since exposures can be taken automatically using the MX516 camera! During this period the transparency of the sky varied, as monitored by the apparent brightness of a star; the derived magnitude (what I call here the zero-point magnitude) was calculated from the actual V magnitude minus the instrumental magnitude, v (where v = -2.5 times the logarithm to base 10 of the integrated counts in the CCD image of the reference star on any particular CCD frame). The sky was actually constant as seen from Cheshire, amazingly, for a period of 3 or 4 hours, and so I was able to use that period which comprised enough data (40-50 frames) for the analysis.



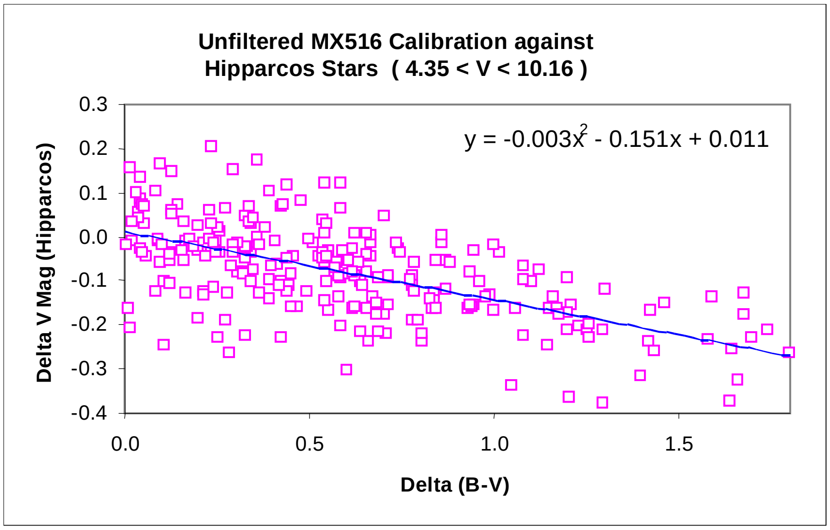
* V = Johnson V Magnitude (from Guide 7.0), v = instrumental magnitude (unfiltered)

Figure 1 (above) and Figure 2 (below)



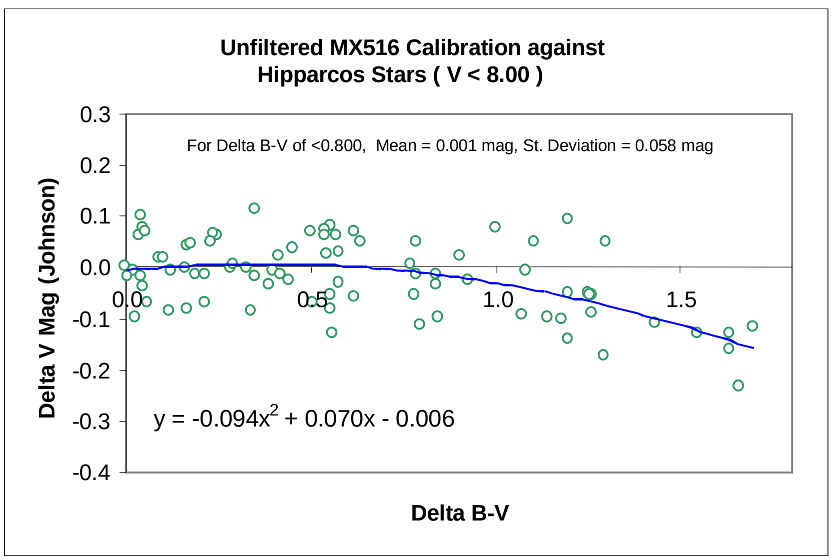
298 Hipparcos stars used involving 247 differential measures from 53 CCD frames

Unflat-fielded, and using Hipparcos stars, the frame-to-frame variation amounted to only about +/-0.03 magnitudes as shown in Fig.1. Here I have only included brighter stars (V < 8.0) to ensure that we have enough photons to minimise the statistical fluctuations in intensity. The sky itself would inevitably be varying somewhat, so that taking this out, the residual frame-to-frame variation is likely to have amounted to about 2% standard deviation, i.e. 0.02 magnitude. Then I looked at all of the frames. There were 298 Hipparcos stars (247 pairs) in all. The analysis of these is shown in Figures 2 and 3. Notice that a quadratic accurately fits the relationship between the measured difference in V magnitude, and the colour index, B-V,



298 Hipparcos stars used involving 247 differential measures from 53 CCD frames

Figure 3 (above) and Figure 4 (below)



124 Hipparcos stars used involving 83 differential measures from 41 CCD frames

and that the intercept of 0.005 mag indicates that the data is not biased in any way (i.e. it is very close to the theoretical intercept which should be zero). In fact, the lack of significant bias is one of the real advantages of CCDs used in this mode (without flat fields). You don't actually introduce any bias, provided that you allow the star images to move around the frame; in this way the CCD is a marvellous *randomiser* so that the average of a large number of frames approaches the *true* value, whereas if you apply a faulty flat-field and the star images remain on the same relative positions in the frame, you just get closer and closer to the faulty biased flat-field value.

As well as the correlation with the value of the V magnitude, I derived the correlation with the Hipparcos Hp magnitude, which actually resulted in a straight-line relationship. Figure 3 is produced using all the data, whereas Figure 5 gives the correlation for stars brighter than V = 8.00, which clearly shows less scatter, but again shows the same linear relationship with an intercept of only -0.004 magnitude. The plot ranges from a B-V difference of zero up to +1.8 as we only have the Hipparcos stars to work with. This is fine for asteroid photometry but many variable stars are much redder.

During the Hipparcos mission, photometry was carried out using three passbands as shown in Figure 6 (copied from Figure 1.3.1 of the Introduction to the Hipparcos/Tycho catalogue). Two filters yielded the Tycho BT and VT values, whereas the third was a much broader passband giving the Hp magnitude. To get a linear relation such as that shown in Figure 5,

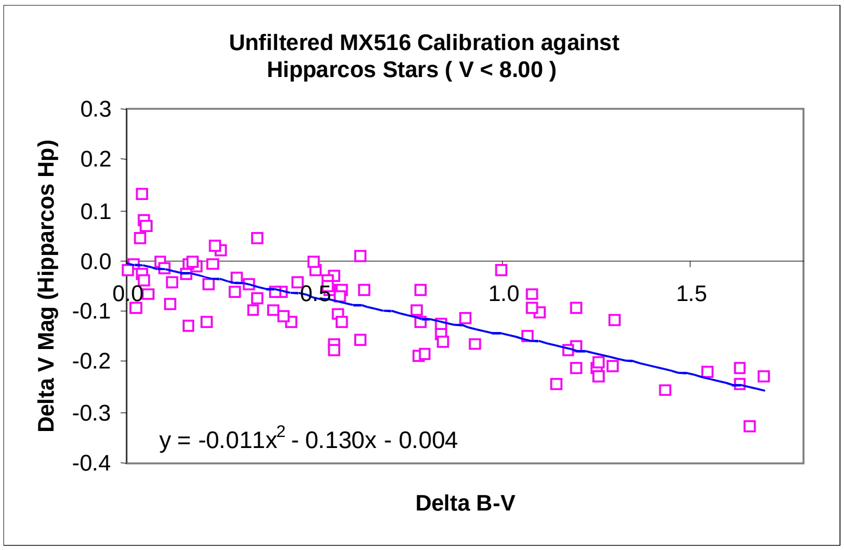
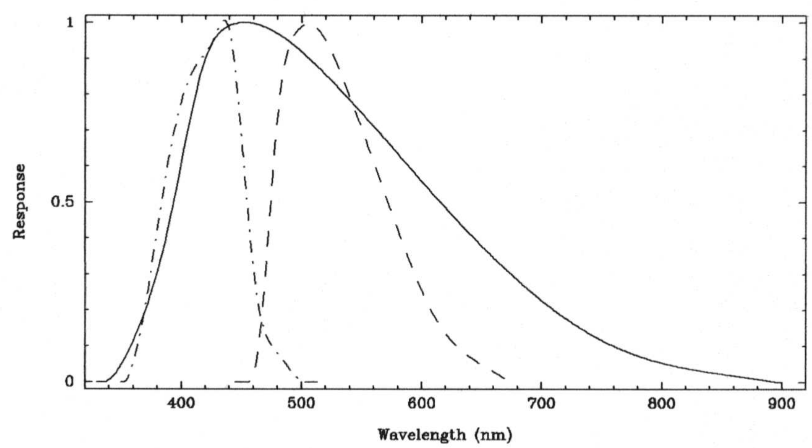


Figure 5

124 Hipparcos stars used involving 83 differential measures from 41 CCD frames

Figure 6, below, The Hipparcos (Hp, solid line) and Tycho (BT, dot-dash line, and VT, long-dash line, photometric systems)



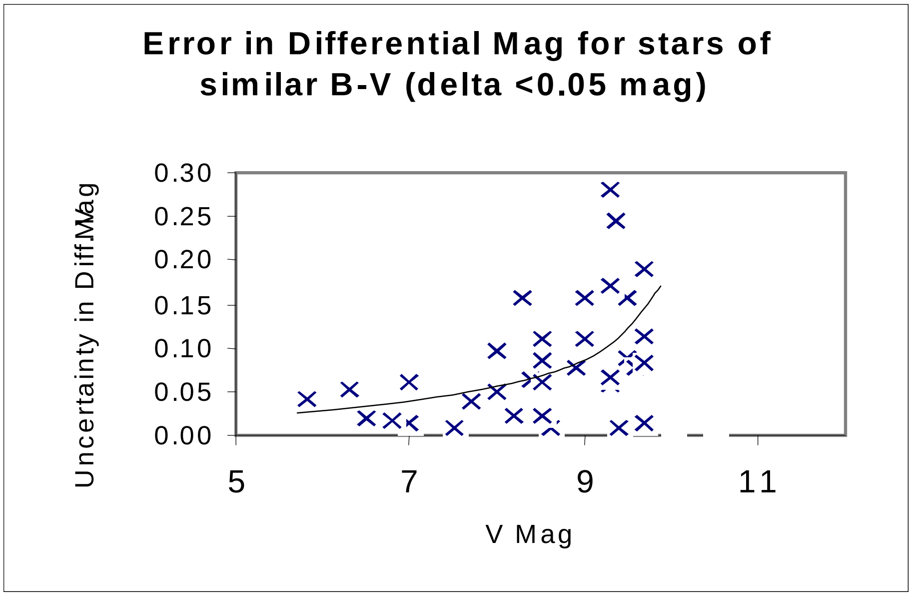


Figure 7

the detection across the spectrum must be similar for Andy's photometer compared to that for the Hipparcos Hp photometric system. As is the case for the Starlight Xpress camera, you have a pseudovisual type response for the Hp system, with the red/infrared end of the spectrum being progressively cut-off. The Hipparcos response curve is therefore similar to that of the MX516 camera, but it is shifted to the blue end of the spectrum (mid-point of about 480 nm, compared to an equivalent value of 550 nm for the Sony CCD chip used in the MX516). Compared to Hipparcos therefore, when you do the transformation, you find that the MX516 exaggerates the brightness of stars the further one goes to the red. You can probably extrapolate this relation to even redder stars, say with B-V colour indices of about +3.0.

Figure 7 depicts the errors in the differential V magnitude obtained for some star pairs, where the difference in colour of the two stars is small (<0.05 mag). This shows that the uncertainty in the derived magnitude begins to increase significantly as you go from magnitude 8 to magnitude 9 and beyond. But it should be borne in mind that these data were obtained with a very small aperture (3.5 cm working at f/4) and short 8-second exposures. If you were to go to a driven mounting, and to a somewhat larger aperture (faster focal ratio) then you would easily get down to magnitude 11 or 12, or even to magnitude 13 in less crowded areas of the sky. The beauty of the methodology is that if you add frames you will get closer to the true V magnitude if you utilise the Hipparcos dataset.

Very clearly for asteroid work you should be able to carry out V-band photometry quite straightforwardly. The passband of the Starlight Xpress is actually helping you, as you are able to transform from the measured instrumental magnitude, provided you have enough Hipparcos stars on the frame and if the colour difference of the star and the asteroid is not too large. Indeed the tolerance is quite good in that a 0.7 magnitude difference in B-V will introduce no error greater than about 0.01 mag. I estimate that for unfiltered and non-flat-fielded images of stars brighter than magnitude 8, just using single frames will give an accuracy of about +/-0.06 magnitude, whereas if you average/randomise several frames, it should be possible to reach an accuracy within 0.02 or 0.03 mag of the true V magnitude value.

In fact Andy did have **U Orionis** on one of his frames and so it should be possible to report a result for this long-period variable - see the postscript opposite!

Certainly this treatment applies to all asteroids and to some variables, but the real work now is to extend this methodology to much redder stars. The Hipparcos people worked with the AAVSO to determine the correlation for very red stars between the observed magnitude and the Hipparcos magnitudes. What you need to do is to be able to transform your data. To do that, you need to know the colour of the variable stars for much redder stars (i.e. a B-V of +3 to +5 or greater). So I think there is quite a good project that I can propose, in which someone does two-colour photometry so that we can establish what our programme stars' colours are. So if anyone then wishes to do single-filter or even unfiltered CCD photometry, you could actually get quite accurate V-band magnitudes but you do need to know the colours of our variable stars at each phase in their cycle. Easy!

Question from Nick James: I'm a bit worried about doing photometry without doing flat fields, although your results do look quite good. Were you saying something more about flat fields? Basically, I know that if you do a bad flat-field you can make matters even worse, however, you said something earlier on that seemed to suggest more than this; were you actually positively persuading people not to do flat-fields in order to take advantage of the randomising effect which you have referred to?

Reply from Richard Miles: You do need to encourage people to pursue this type of work, and so avoiding flat-fields avoids the additional complexity that these introduce, which might otherwise discourage people. If you keep all your optical surfaces reasonably clean, and you have the Hipparcos stars on the frame then, so long as you take several shots at different positions, you can derive sensible magnitudes without worrying about flat fields.

Reply from Andy Hollis: Given my own change in circumstances, the philosophy behind this work was to find a simple way by which you could produce scientifically useful results. I knew that visual observations were actually accurate to typically 0.1 or 0.2 magnitude, and I wanted to get slightly better than this but without any form of bias. What I'm doing is undriven, and because I'm taking multiple exposures, the general drift of the object through the field between successive exposures is, to some extent, compensating for the fact that I haven't done the flat-fielding because I'm not relying on one image; so if it's over a 'doughnut' for one image, it won't be for subsequent ones.

Further point from Nick James: Wouldn't the accuracy be even better if you also did carry out flat fields?

Reply from Richard Miles: The most telling result is the atmospheric transmission one (Figure.3), because this represents lots of different stars on lots of frames. Here the standard deviation was only 0.038 mag over a period of some 3.8 hours. The scatter is less in reality, because the atmosphere itself would have also varied during this period. On a single frame, we appear to be getting to within +/-2% photometrically flat at any point across the frame. Repeat imaging, in which the variable and reference stars are allowed to move around the frame will reduce this flat-field error even more.

POSTSCRIPT

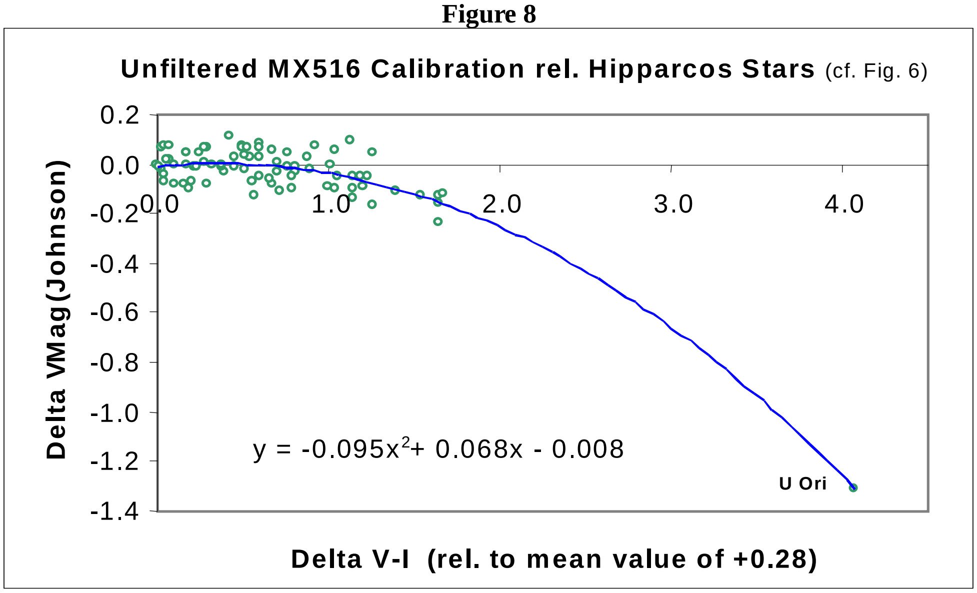
After the meeting, I looked at the results referred to above regarding the variable, U Orionis. This star is indeed *very red*. The listed average B-V for this star is +1.5, however this value is misleading. As pointed out in the Introduction to the Hipparcos/Tycho Catalogue, the most pertinent colour index for transforming magnitudes is not B-V, but rather V-I. For U Orionis, its V-I index is around +4.2 when it is near maximum, and as red as +6.3 when at minimum (ref. AAVSO BVRI database, JD 2,452,180-2,452,320). I have therefore replotted the correlation between the delta Johnson V magnitude, in which I have utilised the V and V-I measurements which were made only 3 days after Andy's frames (two of which showed U Ori), as reported by the AAVSO on their website. The results are shown plotted in Figure 8.

Interestingly, the addition of this extra point at a much redder value than previous data points, results in a quadratic plot that has virtually the same relationship as was obtained earlier using only Hipparcos stars (Figure 4).

Clearly, to establish an accurate transformation plot, of use in observing red variables, we need to extend Figure 8 by adding further points for a small number of variables observed at various points in their cycles. Two-colour photometry should therefore be restricted to the V-band and I-band, and a transformation plot constructed accordingly. The use of B-V indices should be avoided. Fortunately, the Hipparcos dataset includes V-I values for virtually all 118,000 stars in the catalogue.

Note that a further advantage of working unfiltered, is that the sensitivity of the Sony chip for observing very red stars will allow observers to measure variables some 2 to 3 magnitudes fainter than would be possible for normal stars. Many stars should therefore be able to be followed through minimum even using relatively small apertures.

Figure 8



RECENT PAPERS ON VARIABLE STARS

DICK CHAMBERS

Unique Type Ia Supernova 2000 CX in NGC 524, W.Li, A.V.Fillippenko, E.Gates, R.Charnock, A.Gal-Yam, E.O.Ofek, D.C.Leonard, M.Modjaz, R.M.Rich. A.G.Reis and R.R.Treffers, PASP Vol. 113. No. 788 (October 2001)Page 1178.

Extensive photometric and spectroscopic observations of this Type Ia supernova are presented. These data show the object to be peculiar, with some similarities to SN 1991T-like objects but with a different spectral evolution. Theoretical models suggest that SN 2000CX may be an overluminous object with a larger yield of 56Ni, and a higher kinetic energy in the ejecta. Implications for the light-curve width - luminosity relationship are briefly considered.

*Line Identifications in the Spectrum of **η Carinae** as observed in 1990-1991 with CCD Detectors, G.Wallenstein, K.K.Gilroy, T.Zethson, S.Johansson and F.Hammen, PASP Vol. 113. No. 788 (October 2001) page 1210*

Accurate wavelengths, peak intensities and line identification of emission lines in (η Carinae between 3093 to 4432A, and 5696 to 8956A, are presented, together with the wavelengths of interstellar absorption lines and diffuse interstellar bands. The data are briefly discussed with respect to ionization state, the presence of oxygen lines and the state of ionization by the use of [SiII] lines.

*The Intriguing New Cataclysmic Variable **KUV 03580 + 0614,** P.Szkody, B.G.Gansicke, F.Fried, U.Heber, D.K.Erb, PASP Vol. 113. No. 788 (October 2001), page 1215*

Photometric and spectroscopic observations of this object reveal it to be a cataclysmic variable with an orbital period of 3.4 hours. The data, together with a lack of strong X-rays, indicate a system similar to V795 Her, LS Peg and AH Men.

*The Underlying White Dwarf Accretor in the Dwarf Nova **UU Aquilae**, M.Stump and E.N.Sion, PASP Vol. 113. No. 788 (October 2001), page 1222*

The underlying white dwarf in this U Gem type dwarf nova has been identified from far UV spectral observations. The best-fit model atmosphere gives a temperature of 27000±1000K which is consistent with predictions, and within the range for other accretors in U Gem systems.

BVRI Photometry of Supernovae, W.C.G.Ho, S.D.Van Dyk, C.Y.Peng, A.V.Filippenko, D.G.Leonard, T.Matherson, R.R.Treffers and M.W.Richmond,PASP Vol.113, No. 789 (November 2001), page 1349.

Optical photometry have been undertaken on one Type IIn supernova (1994Y) and nine **Type Ia supernovae (1993Y, 1993Z, 1993ae. 1994e, 1994M, 1994Q, 1994ae and 1995D)**. The light curves of 1994Y are complicated and indicate a small ejecta mass.

*Light curve and physical parameters of the algol-type binary **TW Cas,** E.Narita, K.P. Schroder and R.C.Smith, The Observatory, Vol. 121, No. 1164 (2001 Oct.), page 308*

This eclipsing binary (V 8.3 - 8.9 m) has been observed using a 20cm telescope and a ST6 CCD camera at Sussex University. A precise period of 1.4283210d has been determined together with a rate of period change: P/P = - 4 (+1) X 10 suggesting slow mass transfer and loss. Some evidence for a trailing mass stream is seen in the light curve.

*Spectroscopic binary orbits from photoelectric radial velocities, Paper 160: HD 44192, HD 45191, and HD 92823 (The Double-Lined Eclipsing Binaries **V454** and **V455 Aurigae** and **UW Leonis Minoris**, R.F.Griffin, The Observatory, Vol. 121, No. 1164 (2001 Oct.), page 315*

All these objects were discovered as eclipsing by Hipparcos. The paper deals with radial velocity data. There appears to be a dearth of photometric evidence apart from Hipparcos.

V454 Aur (HIP 30270) is assigned a 3.2 day period by Hipparcos but, in fact, has a period of 27.0197 days. The component types are F8V and G1/2V, in an orbit of considerable eccentricity (0.38). Eclipses (7.8 - 8.2) occur half an hour earlier each month, and currently are in daylight being observable again in late 2003.

V455 Aur (HIP 30878) has a period of 3.14578, the components being F6 and F7V in a nearly circular orbit. The magnitude range is 7.36 to 7.59. There is a third component in the system with a period of 1350 days.

UW LMi (HIP 52465) has a magnitude range of 8.45 to 8.86. The object has a period of 3.874307 days and consists of two early G-type stars in a circular orbit.

IBVS'S 5081-5200

Gary Poyner

5081 Photometry of **CI Cam** during quiescence in 1999 (Kato & Uemura, 2001)
5082 **FT Cam**: Outburst photometry and proper motion (Kato et al, 2001)
5083 **KN Gem**: Misclassified because of misidentification (Samus, 2001)
5084 Two new Algol-type eclipsing binaries (Williams, 2001)
5085 Large amplitude irregular variable **V559 Lyr** (Kato et al, 2001)
5086 Confirmation of **Z Cir** as a Mira variable. (Jones et al, 2001)
5087 Stability of pulsation of **V577 Ophiuchi** (Zhou, 2001)
5088 The discovery of brightness variations of **GSC 0870-0798** (Robb et al, 2001)
5089 Eight new small amplitude variables(Lebzelter & Posch, 2001)
5090 A study of the non eclipsing binary **SV Geminorum** (Guilbault et al, 2001)
5091 Standstill of the helium ER UMa star **V803 Cen** (Kato et al, 2001)
5092 Outburst photometry of **IS Del** (Kato 2001)
5093 Oscillation during standstill of **Z Cam** (Kato, 2001)
5094 BVRI observations of **CZ Orionis** in outburst (Spogli et al, 2001)
5095 Improved ephemeris for **AQ Com** (Csizmadia & Borkovits, 2001)
5096 CCD Photometry of the field of **EX Cancri** (Zhou, 2001)
5097 Outburst photometry of **TmzV36** (Kato & Uemura, 2001)
5098 Outburst photometry of **DX And** (Kato & Nogami, 2001)
5099 Unusual slow fading of standstill in **AT Cnc** (Kato et al, 2001)
5100 **Nova Aql 2001**: Another V723 Cas-type slow Nova? (Kato & Takamizawa, 2001)
5101 First spectroscopy of the dwarf nova **KX Aql:** A possible new SU UMa system. (Tappert & Menickent, 2001)
5102 Outburst photometry of **IZ And** (Kato, 2001)
5103 Outburst photometry of **FX Cep** (Kato et al, 2001)
5104 Development of late superhumps in **YZ Cnc** (Kato, 2001)
5105 Time resolved photometry of **AH Eri** in outburst (Kato & Nogami, 2001)
5106 Discovery of pulsations in A5(8) V component of the Algol type system **TW Dra** (Kusakin et al, 2001)
5107 Superoutburst observation of **AQ Eri**: Evidence for an anomolous superhump excess? (Kato, 2001)
5108 The 1997 superoutburst of the SU UMa type Dwarf Nova **V2176 Cygni** (Novak et

al, 2001)
5109 On the supercycle length of **HS Vir** (Kato et al, 2001)
5110 On the cycle length of **V1113 Cyg** (Kato, 2001)
5111 The period behaviour of the eclipsing binary **LD 328** (Lloyd et al, 2001)
5112 The nature of the eclipsing binary **LD 328**. (Lloyd et al, 2001)
5113 **EF Cancri:** A new RRc star (Pejcha & Sobotka, 2001)
5114 **GSC 0867.0545**: A new RR Lyrae variable (Moschner et al, 2001)
5115 **NSV 15563** is a new classical Cepheid (Putans & Antipin, 2001)
5116 **UW Tri**: Another likely WZ Sge-type star (Kato et al, 2001)
5117 **RX Cha**: New long period SU UMa type dwarf nova (Kato et al, 2001)
5118 Outburst cycle of **V363 Lyr** (Kato et al, 2001)
5119 Detection of supercycle in **BF Ara:** Normal SU UMa type dwarf nova with the shortest supercycle (Kato et al, 2001)
5120 The second supercycle of the helium ER UMa star **CR Boo** (Kato et al, 2001)
5121 Photometry of **UZ Tau** (Kato et al, 2001)
5122 Observations of superhumps in **IR Gem** (Kato, 2001)
5123 Outburst photometry of **TmzV34** (Kato et al, 2001)
5124 Outburst of **CG Dra** (Kato & Nogami, 2001)
5125 CCD light curves of ROTSE1 variables, X: **GSC 2016.830 Boo, GSC 2022.79 Boo, GSC 2020.736 Boo and GSC 2020.873 Boo** (Blattler & Diethelm, 2001)
5126 Observations of **NSV03799** and **NSV04612** (Merchan-Benitez, Jurado-Vargas2001)
5127 Short term radio variability of **Cygnus X-**1. (Marti et al, 2001)
5128 Superhump in November 2000 superoutburst of **TY Piscium**. (Kunjaya et al, 2001)
5129 The first ground based photometric observations of **V397 Cephei** (Bulut et al, 2001)
5130 **GSC 4431.1446**, a new red variable in Draco (Nomen-Torres & Escola-Sirisi, 2001)
5131 Optical monitoring of the X-ray source **QR And/RX J0019.8+2156** (Simon et al, 2001)
5132 **NSV 2544 Cam**: A W UMa type eclipsing binary (Pejcha et al, 2001)
5133 Variability of Luyten's **GM Sgr** (Kato et al, 2001)
5134 Identification of known and suspected variables from the ROTSE1 survey (Wils, 2001)
5135 The 76th name list of variable stars (Kazarovets et al, 2001)
5136 Times of minima of eclipsing binaries **DI Herculis** and **V1143 Cygni** (Dariush et al, 2001)
5137 On the identifications of **V391 Sct, V2435 Sgr** and Maffei's Infrared variables (Kato, 2001)
5138 The light curve and red spectrum of **Nova V4643 Sgr** in early decline (Bruch, 2001)
5139 A deep dip during an outburst in the old nova **Q Cygni** (Nogami et al, 2001)
5140 The identity of **XY Psc** (Henden et al, 2001)
5141 The identity of **DO Vul** (Henden et al, 2001)
5142 Photoelectric observations of **DR Vulpeculae** (Cicek, 2001)
5143 V,R & I light curves of contact binary system **AK Her** (Varricatt et al, 2001)
5144 The first ground based photometric observations of **GM Draconi** (Cicek et al, 2001)
5145 Photometric observations of the extreme mass ratio, high contact dwarf binary **V902 Sagittarii** (Samec & Corbin, 2001)
5146 CCD Light curves of ROTSE1 variables, XI: **GSC 2066.1210 Her, GSC 2063.902 Her, GSC 2594.1289 Her and GSC 1522.599 Her** (Blattler & Diethelm, 2001)
5147 BVRI Observations of **AH Her** in outburst. (Spogli et al, 2001)
5148 **GSC 5582.0545** is an eclipsing binary of W UMa type. (Frank & Bernhard, 2001)
5149 The light elements and a preliminary photometric solution for the binary **GSC 2530.488** (Bloomer et al, 2001)
5150 **V1178 Sco**: A nova with early stage oscillations. (Kato et al, 2001)

5151 **V608 Cassiopeiae**: CCD light curve and elements of variation (Blattler & Diethelm, 2001)
5152 UBV photometry of the newly found active star **YY Coronae Borealis** (Erdem et al, 2001)
5153 First photometric observations of **MR Delphini** (Soydugan et al, 2001)
5154 BVR photometry of **CW Cephei** (Soydugan et al, 2001)
5155 Detection of the secondary minima in **TX UMa** (Komzik et al, 2001)
5156 **NSV 25616** is a new classical Cepheid (Baranov, 2001)
5157 The SU UMa nature of **V630 Cygni** (Nogami et al, 2001)
5158 Outburst characteristics of three likely SU UMa type dwarf novae: **UV Gem, FS And** and **AS Psc** (Kato et al, 2001)
5159 On the supercycle of two eclipsing SU UMa type dwarf novae: **V2051 Oph and IY UMa** (Kato et al, 2001)
5160 BVR photometry of the short period Algol system **VV UMa** (Arevalo et al, 2001)
5161 **V1542 Aql** is an eclipsing binary of W UMa type. (Quester & Bernhard, 2001)
5162 **GSC 8527-373**: A multimode δ scuti star (Pocs et al, 2001)
5163 Autocorrelation analysis of two pulsating red giants. (Percy et al, 2001)
5164 **USNO-A2.0 0825-15411768:** A new Mira in Aquila (Bedinent, 2001)
5165 Lost Harvard variables in Sagittarius, Scutum and Scorpius recovered on Nantucket and Moscow plates. (Samus et al, 2001)
5166 Photometry of stars near **WZ Sge** (Henden & Landolt, 2001)
5167 **GSC 5002.0629**: A new bright double mode RR Lyrae variable. (Garcia-Melendo et al, 2001)
5168 **GSC 0752.2349** is an eclipsing binary of W UMa type. (Bernhard et al, 2001)
5169 1999 observations of the Solar type eclipsing binary, **TY Ursa Majoris**. (Stoddard et al, 2001)
5170 **UZ CVn**: A century of period increase (Vandenbroere & Berthold, 2001)
5171 **NSV 1012**: A new eclipsing binary (Berthold et al, 2001)
5172 **Nova Sgr 2001 No. 2 = V4739 Sgr** (Livingston et al, 2001)
5173 Observations of H-Alpha emission in **VV Cephei** (Pollmann, 2001)
5174 Photoelectric minimum times of two RS CVn type binary systems: **RT And** & **SV Cam** (Ekmekci, 2001)
5175 A 100 year period study of **V523 Cassiopeiae**: A triple star system? (Samec et al, 2001)
5176 **Brh V35 = GSC 0703-1930** is a short period RRc variable. Bernhard et al, 2001)
5177 **WR 140** in eclipse again. (Panov et al, 2001)
5178 On the orbital periods of two bona-fide λ Bootis stars **HD 64491** and **HD 141851** (Iliev et al, 2001)
5179 The first ground based photometric observations of **V401 Lacertae**. (Bulut & Demircan, 2001)
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5181 New variable stars along the northern Milky Way (Dahlmark, 2001)
5182 V, Ic observations of the variable **Antipin V71** (Bacher et al, 2001)
5183 Spectroscopy and photometry of **V1137 Aql** (Miroshnichenko, 2001)
5184 New photometric photometry of the neglected contact binary **EP And** (Pribulla et al, 2001)
5185 Coordinates and identifications for Dolidze S, C and MS stars. (Skiff, 2001)
5186 **GSC 1172. 1452 (BRH V30)** is a new eclipsing binary of W UMa type. (Moschner et al, 2001)
5187 Coordinates and identifications for Rosino’s red variables near NGC 6749 (Skiff, 2001)

5188 Further improvement of the period and new R light curve of **CQ UMa** (Mikulasek
& Ziznovsky, 2001)
5189 New W UMa tyupe eclipsing binaries in the globular cluster M15 (Jeon et al, 2001)
5190 UBV photometry of the W UMa star **V839 Ophiuchi** (Pazhouhesh et al, 2001)
5191 **V842 Her** A W UMa star with constant period. (Csizmadia, 2001)
5192 CCD light curves of ROTSE1 variables, XII: **GSC 3073.837 Her, ROTSE1 J171239.42+330800.2 Her, GSC 2604.1671 Her & GSC 3094.120 Her** (Blattler
& Diethelm, 2001)
5193 Emission activity of the Be star **28 CMa**: Entering a new cycle? (Stelf et al, 2001)
5194 **GSC 608.143:** A new W UMa variable. (Behrend et al, 2001)
5195 The historical, 1889-2002 light curve of the eclipsing symbiotic binary **AR Pav**. (Skopal et al, 2001)
5196 **ZZ Hyi** is a poorly studied galaxy. (Pastukhova, 2001)
5197 **USNO A 1125.14834179** is a Mira variable. (Masi, 2001)
5198 Photometry and spectrophotometry of the new variable star **IRAS 20192+3025** (West & Alexander, 2001)
5199 Detection of a ternary spectrum in **HD 216608** (Iliev et al, 2001)
5200 First ground based photometrty and preliminary photometric elements of contact binary **DN Cam** (Vanko & Pribulla, 2001)

The Information Bulletin on Variable Stars (IBVS) can be accessed through the WWW in HTML format at the following URL:**http://www.konkoly.hu/IBVS/IBVS.html**

ECLIPSING BINARY PREDICTIONS

TONY MARKHAM

The following predictions, based on the latest Krakow elements, should be usable for observers throughout the British Isles. The times of mid-eclipse appear in parantheses, with the start and end times of visibility on either side. The times are hours GMAT (UT-12h). D indicates that the eclipse starts/end in daylight and L indicates low altitude at the start/end of the visibility. Thus, for example, on Jul 29, TV Cas D09(10)14 indicates that an eclipse of TV Cas starts in daylight, but can be observed between 09h and 14h GMAT (Jul 29 21h UT and Jul 30 02h UT), with mid eclipse at about 10h GMAT (Jul 29 22h UT). Please contact the EB secretary if you require any further explanation of the format.

Note that predictions for **RZ Cas**, **Beta Per**, **Lambda Tau** and **HU Tau** can be found in the BAA Handbook.

2002 Jul 1 Mon
TX UMa D10(08)13
Z Dra D10(11)13
2002 Jul 2 Tue
S Equ D10(10)14D
TW Dra D10(15)14D
2002 Jul 3 Wed
Z Per L10(09)14D
U Cep 11(15)14D
RW Tau L14(09)14
2002 Jul 4 Thu
Z Vul D10(08)13
TX UMa D10(09)14D
ST Per L11(15)14D
2002 Jul 5 Fri
U Sge D10(06)12
TW Dra D10(10)14D
Z Dra 10(13)14D
2002 Jul 6 Sat
Z Per D10(11)14D
Y Psc L11(13)14D
Z Vul 14(19)14D
2002 Jul 7 Sun
TX UMa D10(11)14D
SW Cyg D10(13)14D
TV Cas 12(16)14D
2002 Jul 8 Mon
TW Dra D10(06)11
U Sge D10(15)14D
U Cep 10(15)14D
2002 Jul 9 Tue
Z Vul D10(06)11
S Equ D10(07)12
TV Cas D10(12)14D
Z Per D10(12)14D
Z Dra 12(14)14D
2002 Jul 10 Wed
TX UMa D10(12)14D
Y Psc L11(08)12
2002 Jul 11 Thu
TV Cas D10(07)11
Z Vul 12(17)14D
RW Tau L13(16)14D
2002 Jul 12 Fri
Z Dra D10(07)10
Z Per D10(13)14D
ST Per L10(14)14D
S Equ 12(17)14D

X Tri 14(16)14D

2002 Jul 13 Sat

TX UMa D10(14)14L
U Cep 10(15)14D
X Tri 13(16)14D
Z Dra 14(16)14D

2002 Jul 14 Sun

X Tri 13(15)14D
RW Tau L13(11)14D
SS Cet L14(13)14D

2002 Jul 15 Mon

U Sge D10(09)14D
Z Per 10(15)14D
X Tri 12(14)14D

2002 Jul 16 Tue

Z Dra D10(09)12
Z Vul D10(15)14D
TX UMa 11(15)14L
TW Dra 11(16)14D
SW Cyg 11(17)14D
X Tri 11(14)14D
TV Cas 14(18)14D

2002 Jul 17 Wed

X Tri L11(13)14D
SS Cet L14(12)14D

2002 Jul 18 Thu

TV Cas D10(13)14D
U Cep 10(14)14D
X Tri L11(12)14D
Z Per 11(16)14D
U Sge 13(18)14D

2002 Jul 19 Fri

TW Dra D10(11)14D
S Equ D10(14)14D
X Tri L11(12)14
TX UMa 12(17)13L

2002 Jul 20 Sat

TV Cas D10(09)13
Z Dra D10(11)13
ST Per L10(12)14D
X Tri L10(11)13
SS Cet L14(12)14D

2002 Jul 21 Sun

SW Cyg D10(07)13
Z Vul D10(13)14D
Y Psc 10(15)14D
X Tri L10(10)13
Z Per 13(17)14D

2002 Jul 22 Mon

TW Dra D09(07)12
X Tri L10(10)12
RW Tau 14(18)14D

2002 Jul 23 Tue

U Cep D09(14)15D
X Tri L10(09)11
SS Cet L14(11)15D

2002 Jul 24 Wed

Z Dra 10(13)15D
X Tri L10(08)11
Z Per 14(19)15D

2002 Jul 25 Thu

U Sge D09(13)15D
Y Psc L10(09)14
RW Tau L12(13)15D
SW Cyg 14(20)15D

2002 Jul 26 Fri

Z Vul D09(10)15D
S Equ D09(11)15D
SS Cet L13(11)15D

2002 Jul 27 Sat

TV Cas 11(15)15D

2002 Jul 28 Sun

U Cep D09(14)15D
ST Per L09(11)15D
Z Dra 12(14)15D

2002 Jul 29 Mon

TV Cas D09(10)14
SS Cet L13(10)15

2002 Jul 30 Tue

SW Cyg D09(10)15D
TW Dra 12(17)15D

2002 Jul 31 Wed

TV Cas D09(06)10
Z Dra D09(08)10
Z Vul D09(08)14

2002 Aug 1 Thu

U Sge D09(07)13
SS Cet L13(09)14
Z Dra 14(16)15D

2002 Aug 2 Fri

S Equ D09(08)14
TW Dra D09(12)15D
U Cep D09(13)15D
Z Vul 14(19)15D
ST Per 14(18)15D

2002 Aug 4 Sun

Z Dra D09(09)12
U Sge 10(16)15D
SS Cet L13(09)13

2002 Aug 5 Mon

Z Vul D09(06)11
TW Dra D09(07)12
ST Per D09(10)14

RW Tau L11(14)15D
Y Psc 12(16)15D
TV Cas 12(16)15D
S Equ 13(19)15D

2002 Aug 6 Tue

RW Gem L14(18)15D

2002 Aug 7 Wed

TV Cas D09(12)15D
U Cep D09(13)15D
Z Vul 12(17)15D
SS Cet L13(08)13

2002 Aug 8 Thu

Z Dra D09(11)13
SW Cyg D09(14)15D
RW Tau L11(09)14

2002 Aug 9 Fri

S Equ D09(05)10
TV Cas D09(07)11
Y Psc D09(11)15
RW Gem L14(15)15D

2002 Aug 10 Sat

Z Vul D09(04)09
ST Per 13(17)15D

2002 Aug 11 Sun

U Sge D09(10)15D

2002 Aug 12 Mon

U Cep D09(13)15D
Z Vul 10(15)15D
S Equ 10(16)15D
Z Dra 10(13)15
RW Gem L13(12)15D

2002 Aug 13 Tue

SW Cyg D09(03)10
Y Psc D09(05)10
TX UMa D09(05)10
ST Per D09(08)12
TW Dra 12(17)15D

2002 Aug 14 Wed

U Sge 14(19)15D
TV Cas 14(18)15D
X Tri 15(17)15D

2002 Aug 15 Thu

Z Per D08(04)09
RW Gem L13(09)14
X Tri 14(17)15D

2002 Aug 16 Fri

TX UMa D08(07)11
TW Dra D08(13)15D
TV Cas 09(13)15D
RW Tau 12(16)15D
Z Dra 12(14)15D

X Tri 13(16)15D

2002 Aug 17 Sat

U Cep D08(12)15D
Z Vul D08(13)15D
SW Cyg 11(17)15D
X Tri 13(15)15D

2002 Aug 18 Sun

U Sge D08(05)10
Z Per D08(05)10
TV Cas D08(09)13
ST Per 11(15)16D
X Tri 12(14)16D

2002 Aug 19 Mon

Z Dra D08(08)10
TX UMa D08(08)11L
TW Dra D08(08)13
S Equ D08(13)16D
RW Tau L11(11)15
X Tri 11(14)16D

2002 Aug 20 Tue

TV Cas D08(04)08
X Tri 11(13)16D
Y Psc 13(18)16D
Z Dra 14(16)16D

2002 Aug 21 Wed

Z Per D08(07)12
ST Per D08(07)11
U Sge D08(14)16D
X Tri 10(12)15

2002 Aug 22 Thu

TW Dra D08(04)09
SW Cyg D08(07)13
TX UMa D08(10)11L
Z Vul D08(10)16D
U Cep D08(12)16D
X Tri 09(12)14
TX UMa L14(10)14

2002 Aug 23 Fri

Z Dra D08(09)12
X Tri 09(11)14
TV Cas 15(19)16D

2002 Aug 24 Sat

Z Per D08(08)13
Y Psc D08(12)16D
X Tri L08(10)13
Z Dra 16(18)16D
V640 Ori L16(15)16D

2002 Aug 25 Sun

TX UMa D08(11)11L
X Tri L08(10)12
TV Cas 11(15)16D
TX UMa L14(11)16D

2002 Aug 26 Mon
S Equ D08(09)15
X Tri L08(09)12
ST Per 10(14)16D
RW Gem 15(20)16D
SW Cyg 15(21)16D
V640 Ori L15(15)16D
2002 Aug 27 Tue
Z Vul D08(08)14
Z Per D08(10)14
TV Cas D08(10)14
U Cep D08(12)16D
X Tri L08(08)11
Z Dra 09(11)13
TW Dra 13(18)16D
RW Tau 13(18)16D
2002 Aug 28 Wed
Y Psc D08(07)11
U Sge D08(08)14
X Tri L08(08)10
TX UMa 08(13)11L
TX UMa L13(13)16D
V640 Ori L15(16)16D
2002 Aug 29 Thu
ST Per D08(06)10
TV Cas D08(06)10
X Tri D08(07)09
RW Gem L12(17)16D
Z Vul 14(19)16D
S Equ 15(20)16L
2002 Aug 30 Fri
X Tri D08(06)09
Z Per D08(11)16
TW Dra 09(14)16D
RW Tau L10(13)16D
V640 Ori L15(16)16D
2002 Aug 31 Sat
X Tri D08(06)08
SW Cyg D08(10)16D
TX UMa 10(14)11L
Z Dra 10(13)15
U Sge 11(17)15L
TX UMa L13(14)16D
2002 Sep 1 Sun
Z Vul D08(06)11
U Cep D08(11)16D
RW Gem L12(13)16D
V640 Ori L15(17)16D
2002 Sep 2 Mon
S Equ D08(06)12
TW Dra D08(09)14
Z Per D08(12)16D
RW Tau L10(07)12
2002 Sep 3 Tue
Z Dra D08(06)08
ST Per 09(13)16D
Z Vul 12(17)16L
TV Cas 12(16)16D
TX UMa L13(16)16D
V640 Ori L15(17)16D
2002 Sep 4 Wed
U Sge D08(02)08
RW Gem L12(10)15
Z Dra 12(15)16D
Y Psc 15(19)16D
2002 Sep 5 Thu
TW Dra D08(04)09
TV Cas 08(12)16
Z Per 09(14)16D
S Equ 12(17)15L
V640 Ori 15(18)16D
2002 Sep 6 Fri
Z Vul D08(04)09
ST Per D08(04)08
U Cep D08(11)16
TX UMa L13(17)16D
2002 Sep 7 Sat
TV Cas D07(07)12
Z Dra D07(08)10
U Sge D07(11)15L
RW Gem L12(07)12
RW Tau 15(20)16D
V640 Ori 16(18)16D
2002 Sep 8 Sun
Y Psc 09(14)16D
Z Vul 10(15)15L
Z Per 10(15)16D
Z Dra 14(16)16D
ST Per 16(20)16D
2002 Sep 9 Mon
S Equ D07(03)09
SW Cyg 08(14)16D
TX UMa 14(19)16D
V640 Ori 16(19)16D
2002 Sep 10 Tue
RW Tau 10(14)16D
TW Dra 14(19)16D
2002 Sep 11 Wed
Z Dra D07(09)12
U Cep D07(11)16
ST Per 07(11)16
Z Per 11(16)16D
2002 Sep 12 Thu
Y Psc D07(08)13
S Equ 08(14)15L
TV Cas 14(18)16D
TX UMa 16(20)16D
Z Dra 16(18)16D
2002 Sep 13 Fri
Z Vul 07(13)15L
RW Tau L09(09)14
TW Dra 09(14)16D
2002 Sep 14 Sat
SW Cyg D07(04)10
U Sge D07(06)11
TV Cas 09(13)16D
Z Per 13(18)16D
2002 Sep 15 Sun
Z Dra 09(11)14
RW Gem 16(21)16D
X Tri 16(19)16D
2002 Sep 16 Mon
TV Cas D07(09)13
TW Dra D07(10)15
U Cep D07(10)15
ST Per 14(19)16D
X Tri 16(18)16D
2002 Sep 17 Tue
U Sge 09(15)14L
Z Per 14(19)16D
X Tri 15(17)16D
2002 Sep 18 Wed
TV Cas D07(04)09
Z Vul D07(11)15L
SW Cyg 11(17)17D
RW Gem 13(18)17D
X Tri 14(17)17D
2002 Sep 19 Thu
TW Dra D07(05)10
ST Per D07(10)14
S Equ D07(11)14L
Z Dra 11(13)15
X Tri 13(16)17D
Y Psc 16(21)17D
2002 Sep 20 Fri
X Tri 13(15)17D
Z Per 16(20)17D
2002 Sep 21 Sat
U Cep D07(10)15
RW Gem L11(15)17D
RW Tau 11(16)17D
X Tri 12(15)17D
TV Cas 15(19)17D
2002 Sep 22 Sun
Z Dra D07(06)08
X Tri 11(14)16
2002 Sep 23 Mon
SW Cyg D07(07)13
Z Vul D07(08)14
Y Psc 11(15)17D
X Tri 11(13)16
TV Cas 11(15)17D
Z Dra 12(15)17D
2002 Sep 24 Tue
U Sge D07(09)14L
RW Tau L08(11)15
X Tri 10(13)15
RW Gem L11(12)17
ST Per 13(17)17D
TW Dra 15(20)17D
2002 Sep 25 Wed
TX UMa D07(02)07
TV Cas D07(10)15
X Tri 09(12)14
Z Vul 14(19)14L
2002 Sep 26 Thu
S Equ D07(08)13
Z Dra D07(08)10
U Cep D07(10)15
X Tri 09(11)14
2002 Sep 27 Fri
TV Cas D07(06)10
ST Per D07(09)13
Y Psc D07(10)14
RW Tau L08(05)10
X Tri 08(10)13
TW Dra 10(15)17D
RW Gem L10(08)13
U Sge 12(18)13L
Z Dra 14(16)17D
SW Cyg 15(21)17D
2002 Sep 28 Sat
TX UMa D07(04)09
Z Vul D07(06)12
X Tri 07(10)12
2002 Sep 29 Sun
X Tri 07(09)12
S Equ 13(18)14L
SS Cet 16(21)17D
2002 Sep 30 Mon
X Tri D07(08)11
TW Dra D07(11)16
Z Dra 07(10)12
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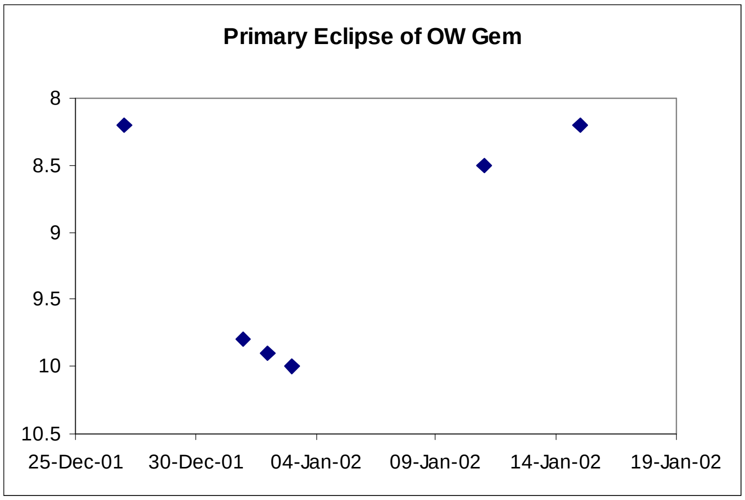
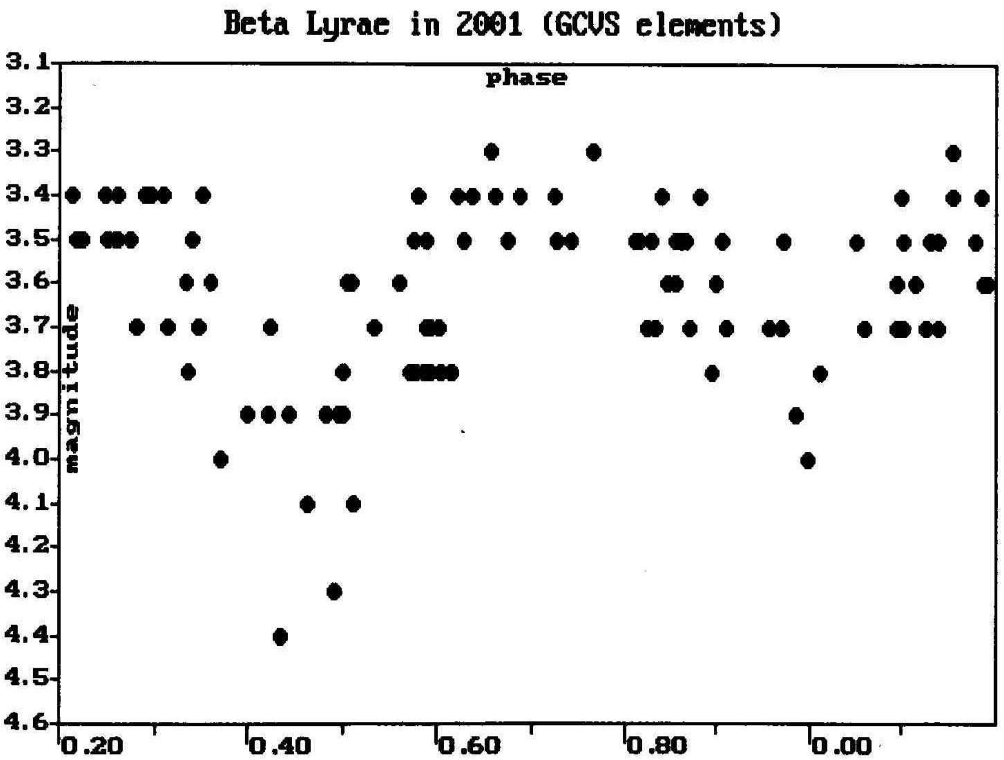
TV Cas 17(21)17D



OW Gem 2002
Observer : Alex Vincent

This long period Algol type variable has a period of approx 1259 days (3.45 years). The brightness range is listed as 8.2-10. The next eclipse, in June 2005, occurs near conjunction, but there will be a more favourable eclipse in Nov 2008.



The deadline for contributions to the issue of VSSC113 will be 15th July. All articles should be sent to the editor (details are given on the back of this issue)

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